withdrawal for one unit would be 4200 gpm (6.05 MGD), with a net consumption of 2778 gpm (4.0 MGD); maximum withdrawal for two units is assumed to be twice this amount. The intake volume for two units represents 2.2 percent of the average river flow of 370,833 gpm (534 MGD or 810 cfs); the consumptive portion represents about 1.52 percent of the average river flow. Since the tidal flushing volume is about 10 times the river flow, the makeup water withdrawal for two units represents only about 0.2 percent of the total available water moving past the withdrawal point. The withdrawal for one unit would represent about half that percentage. When water quality conditions in the river are sufficient to allow it, Delmarva Power will increase the cycles of concentration from three up to six. Water withdrawal for one unit with six cycles of concentration would be reduced to 3310 gpm (4.8 MGD).

PPRP's evaluation of surface water withdrawals from the Nanticoke River indicated potential water quality or quantity impacts from operation of either one or two Dorchester units will be small. Surface water appropriations of 3,400 gpm for average daily use or 4,200 gpm under maximum use conditions are reasonable in relation to the intended use as cooling tower makeup. Since the makeup water withdrawal for two units represents only about 0.2 percent of the total available water moving past the intake point, it is also very unlikely that any adverse or unreasonable impacts would result to the waters of the state or other downstream users from operating Unit 1. Operating the cooling tower system at six cycles of concentration would reduce withdrawal by approximately 20 percent, further reducing the potential for adverse impacts to the Nanticoke River.

**Discharges**

Thermal

The maximum blowdown volume from one unit will be 1400 gpm (2.02 MGD). As illustrated in Table 4-12, discharge water temperature varies with air temperature and humidity (as measured by wet bulb temperature). The table illustrates month to month variation and morning to afternoon differences. Monthly average blowdown temperature varies from 71.7 to 84.2°F and projected salinity in the blowdown varies from 2.28 to 29.4 ppt. The differences between the blowdown temperature and receiving water temperatures vary from 0.2 to 37.7°F. These factors all play a role in the characteristics and impacts of the thermal plume in the Nanticoke River.

## *Table 4-12 Dorchester 1 Makeup and Blowdown*

| Month | Time | Dry Bulb Temp (F) | Wet Bulb Temp (F) | Makeup Flow (gpm) | Blowdown Flow (gpm) | Blowdown Temp (F) | River Water Temp (F) | Delta Temp (F) | Blowdown Salinity (ppt) |
|---|---|---|---|---|---|---|---|---|---|
| JAN | AM | 34.2 | 27.5 | 2854 | 950 | 71.7 | 34 | 37.7 | 27.00 |
| JAN | PM | 41.1 | 27.6 | 3076 | 1025 | 71.7 | 34 | 37.7 | 27.00 |
| FEB | AM | 35.3 | 27.7 | 2858 | 952 | 71.7 | 37 | 34.7 | 27.00 |
| FEB | PM | 46.0 | 28.6 | 3111 | 1036 | 71.7 | 37 | 34.7 | 27.00 |
| MAR | AM | 41.8 | 35.4 | 2987 | 995 | 71.7 | 52 | 19.7 | 12.00 |
| MAR | PM | 54.2 | 35.7 | 3387 | 1128 | 71.7 | 52 | 19.7 | 12.00 |
| APR | AM | 47.4 | 42.4 | 3021 | 1006 | 71.7 | 62 | 9.7 | 5.40 |
| APR | PM | 61.7 | 43.3 | 3543 | 1180 | 71.7 | 62 | 9.7 | 5.40 |
| MAY | AM | 55.0 | 51.5 | 3144 | 1047 | 75.7 | 70 | 5.7 | 2.28 |
| MAY | PM | 70.5 | 51.9 | 3706 | 1234 | 75.8 | 70 | 5.8 | 2.28 |
| JUN | AM | 65.8 | 61.6 | 3343 | 1113 | 80.5 | 75 | 5.5 | 5.40 |
| JUN | PM | 82.3 | 60.9 | 3964 | 1320 | 80.2 | 75 | 5.2 | 5.40 |
| JUL | AM | 70.6 | 68.6 | 3373 | 1123 | 84.2 | 84 | 0.2 | 24.60 |
| JUL | PM | 85.6 | 68.6 | 3924 | 1307 | 84.2 | 84 | 0.2 | 24.60 |
| AUG | AM | 69.9 | 67.8 | 3364 | 1120 | 83.7 | 83 | 0.7 | 26.10 |
| AUG | PM | 83.5 | 67.0 | 3881 | 1293 | 83.3 | 83 | 0.3 | 26.10 |
| SEP | AM | 61.9 | 59.4 | 3244 | 1080 | 79.4 | 77 | 2.4 | 3.06 |
| SEP | PM | 77.3 | 59.7 | 3805 | 1267 | 79.6 | 77 | 2.6 | 3.06 |
| OCT | AM | 49.8 | 45.9 | 3056 | 1017 | 73.1 | 63 | 10.1 | 29.40 |
| OCT | PM | 67.2 | 46.5 | 3685 | 1227 | 73.4 | 63 | 10.4 | 29.40 |
| NOV | AM | 43.8 | 38.2 | 3012 | 1003 | 71.7 | 56 | 15.7 | 12.06 |
| NOV | PM | 57.4 | 37.5 | 3473 | 1157 | 71.7 | 56 | 15.7 | 12.06 |
| DEC | AM | 35.9 | 27.9 | 2892 | 963 | 71.7 | 43 | 28.7 | 8.97 |
| DEC | PM | 45.5 | 28.7 | 3111 | 1036 | 71.7 | 43 | 28.7 | 8.97 |

NOTE:
maximum cooling tower rate = 155,400 gpm
blowdown temperature = cooling tower basin cold water temperature
hot water temperature = cold water temperature + 20 F
design WB = 79 F    design DB = 93 F
design makeup = 4,151 gpm    design blowdown = 1,400 gpm

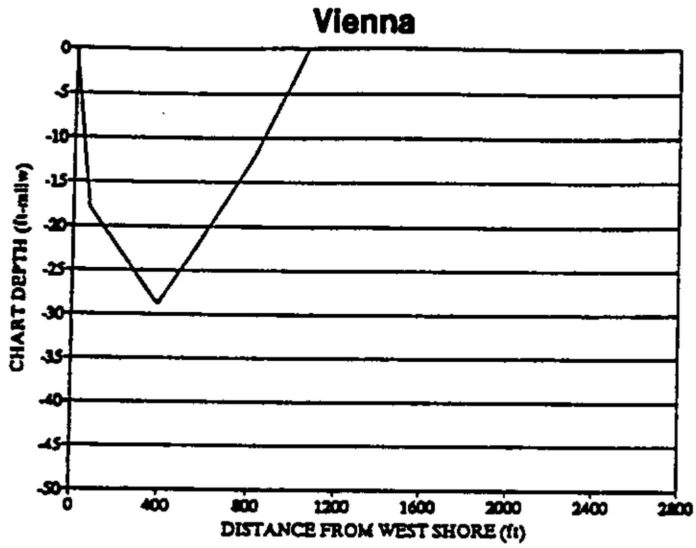
River water temperatures are based on Vienna 9 CPCN Table 2.2b.5 for year 1977. Dry bulb temperature and wet bulb temperature are from National Climatic Data Center in Asheville, North Carolina for Salisbury, Maryland, for the years 1987 through 1991.

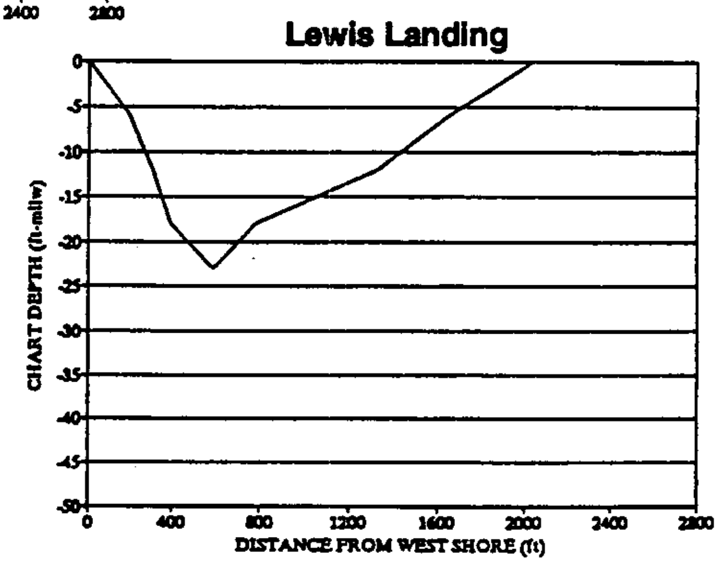
Source: Delmarva Power, Phase II CPCN Application, 1993 (Table 5.1.1-1).

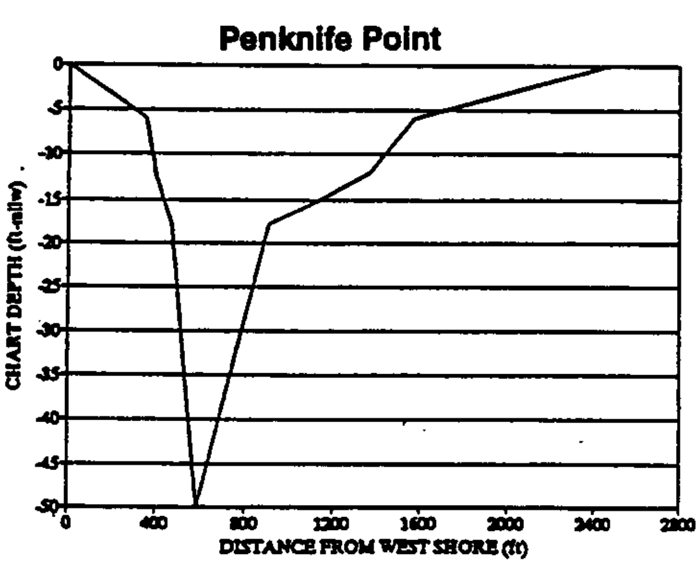
The strictest regulation defining the extent of a thermal discharge into Maryland waters specifies that it not increase the receiving water temperature by more than 2°C above ambient at a distance of 50 feet from the point of discharge (COMAR 26.08.03.03 C (1)). Delmarva Power used the USEPA-sponsored mixing zone model for submerged discharges, CORMIX1 (Doneker and Jirka 1990), to describe the expected behavior of the thermal plume from one unit. This model describes the hydrodynamic near-field behavior of a discharge based on its momentum (energy due to movement of the flow) and buoyancy (due to the difference in density of the discharge water from the receiving water caused by temperature and/or salinity differences) relative to the receiving water body. PPRP reviewed Delmarva Power's use of the CORMIX1 model and concurred with its application for this project. Inputs to the model include the configuration of the discharge and receiving water (Figure 4-1), discharge volume and density, and receiving water velocity and density. Delmarva Power ran simulations for each month of the year using the morning and afternoon monthly averages of cooling tower blowdown temperatures, flows, and salinities. Delmarva Power used monthly average temperatures and salinities for the Nanticoke River to represent conditions in the receiving water. Because the model assumes a uniform ambient flow velocity and steady ambient flow, Delmarva Power used an average flood tide velocity of 1.0 fps and an average ebb tide velocity of 1.2 fps.

Results of the mixing zone modeling for one unit show that the largest plume would occur for the December ebb tide conditions. The large delta-T for that month results in a greater distance required to reach a 2°C difference between ambient and discharge points. However, this maximum plume will only be 12 feet, well within the 50-foot allowable mixing zone. According to model results, because the effluent has a greater density than the receiving water (due to its greater salinity), it will sink and approach but not contact the bottom. Because the existing Vienna Unit 8 power plant discharge will occur within 200 feet of the Dorchester discharge, the model was also used to examine the possible interaction of the two effluent plumes. Results show that the two plumes remain a minimum of 140 feet apart, even under worst-case (maximum plume size) conditions (Figure 4-2). Delmarva Power simulated a two-unit Dorchester discharge, assuming that the discharge volume doubled and that the delta-T and ambient velocity would remain the same. Results of this simulation for worst-case conditions (Table 4-13) show the resulting plume would not exceed 20 feet, well within the 50-foot limit.

## Figure 4-1
## Nanticoke River Channel Cross Sections for Vienna, Lewis Landing, and Penknife Point Derived from NOS Chart 12261 (May1991)
### Dorchester Site




Source: Delmarva Power Phase II CPCN Application, 1993 (Figure 2.3.5-2).

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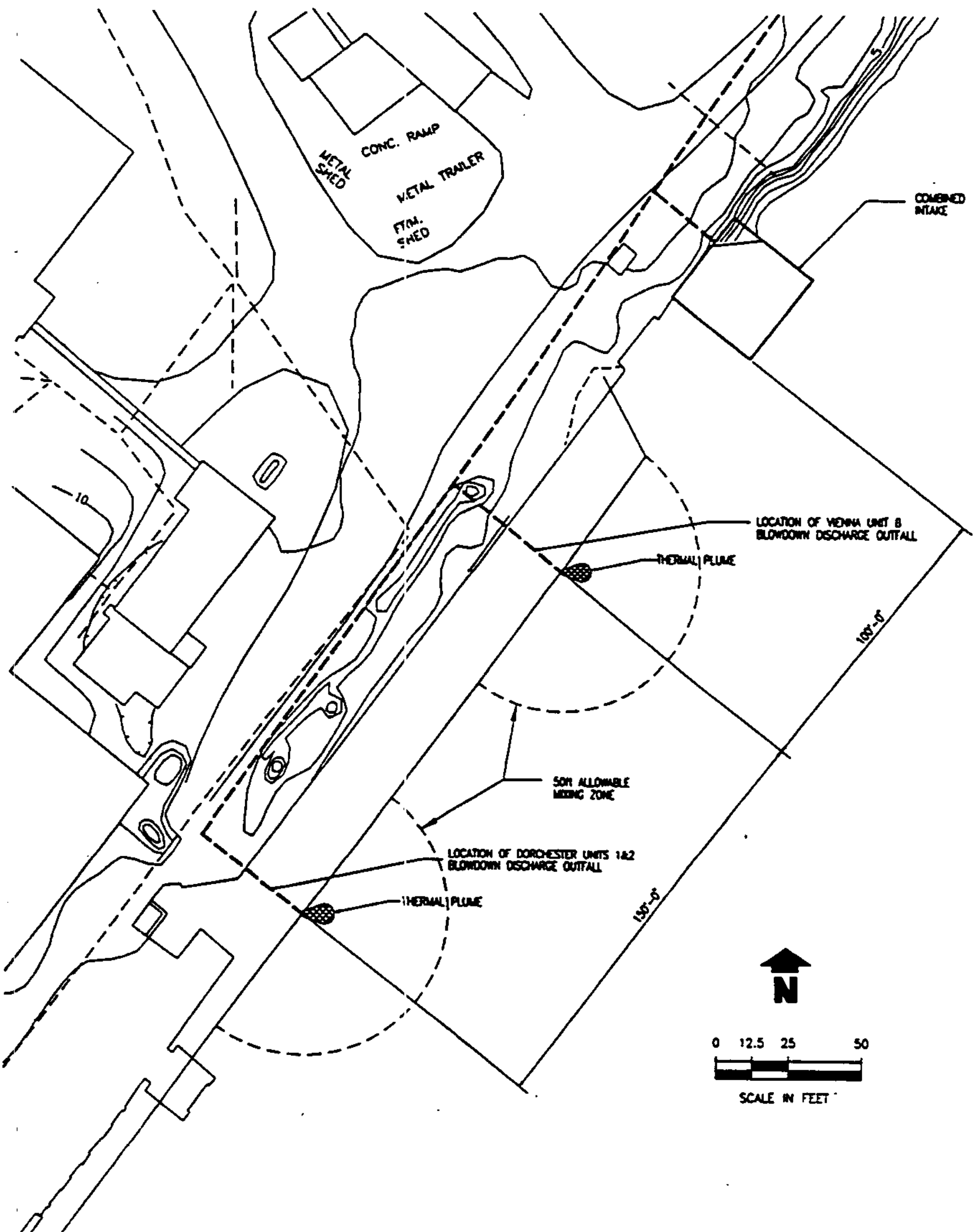
# Figure 4-2
## Relative Size of Predicted Thermal Plumes for the Dorchester 1 and Vienna 8 Discharge Plumes




Source: Delmarva Power Phase II CPCN Application, 1993 (Figure 5.1.1-1).

When water quality conditions in the river are sufficient to allow it, Delmarva Power will increase the cycles of concentration from three cycles to up to six cycles. Blowdown discharge for one unit with six cycles of concentration would be reduced to 561 gpm (0.8 MGD) and the resulting thermal plume would be smaller in size than for three cycles.

*Table 4-13 Two Units—January and December Scenarios*

| | | | | | | | | | Thermal Mixing Zone Dimensions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Tide | Time | Blow-down Flow (gpm) | (mgd) | Blow-down Temp (F) | River Water Temp (F) | Delta Temp (F) | Blow-down Salinity (ppt) | Length (ft) | Width (ft) | Distance From Bottom (ft) | Dilution Ratio at Edge of 50 ft Mixing Zone |
| JAN | Ebb | AM | 1900 | (2.736) | 71.7 | 34 | 37.7 | 27.00 | 17.8 | 9.3 | 7.0 | 21.8 |
| JAN | Ebb | PM | 2050 | (2.952) | 71.7 | 34 | 37.7 | 27.00 | 17.2 | 10.0 | 7.1 | 22.0 |
| JAN | Flood | AM | 1900 | (2.736) | 71.7 | 34 | 37.7 | 27.00 | 17.1 | 11.1 | 6.4 | 24.0 |
| JAN | Flood | PM | 2050 | (2.952) | 71.7 | 34 | 37.7 | 27.00 | 16.4 | 11.9 | 6.5 | 24.1 |
| DEC | Ebb | AM | 1926 | (2.773) | 71.7 | 43 | 28.7 | 8.97 | 14.4 | 8.5 | 8.5 | 19.4 |
| DEC | Ebb | PM | 2126 | (3.061) | 71.7 | 43 | 28.7 | 8.97 | 14.3 | 9.2 | 8.5 | 18.6 |
| DEC | Flood | AM | 1926 | (2.773) | 71.7 | 43 | 28.7 | 8.97 | 13.0 | 10.0 | 8.4 | 19.8 |
| DEC | Flood | PM | 2126 | (3.061) | 71.7 | 43 | 28.7 | 8.97 | 13.2 | 10.9 | 8.3 | 21.4 |

NOTE: average ebb velocity = 1.2 fps
average flood velocity = 1.0 fps

Source: Delmarva Power Phase II, CPCN Application, 1993, (Table 5.1.1.4)

<u>Toxics</u>

Cooling tower blowdown discharged to the Nanticoke River could consist of potentially toxic constituents. Most of the blowdown constituents will originate from Nanticoke River water (maximum 4200 gpm or 6.05 MGD per unit) that has been concentrated three to six times by cooling tower evaporation. About 52 gpm (0.075 MGD) of the make-up water will originate from the wastewater treatment plant, which includes waste originating from various plant processes, potentially oily waste streams, coal pile runoff, and stormwater from the working areas of the combustion by-product disposal area. Smaller amounts of some constituents will originate from corrosion of the copper/nickel alloy intake screen and cooling tower additives.

In order to estimate the chemical characteristics of the blowdown, Delmarva Power used available water quality data for the Nanticoke River from various sources, as well as estimates for the chemical loadings from the other components of the blowdown. Using average river water quality values and maximum cooling tower blowdown, and assuming three cycles of concentration, only two constituents, copper and chromium, will exceed the acute water quality criteria listed in COMAR 26.08.02.03-2G(1) at the end of the pipe (Table 4-14). Average river concentrations of copper are approximately 0.006 mg/l; with three cycles of concentration, the concentration of copper in the blowdown will be 0.018 mg/l. An additional 0.007 mg/l of copper will be released from corrosion of the intake screen, resulting in a total effluent value of 0.025 mg/l, slightly higher than the 0.018 mg/l allowed. Delmarva Power believes the copper values recorded in existing water quality data for the river are higher than actual conditions, since the studies producing these values did not use the latest 'ultra clean' laboratory techniques. Because the 0.025 mg/l copper and 0.05 mg/l chromium values at the end of the pipe exceed the specified limits, regulations allow for a mixing zone (COMAR 26.08.02.05). The allowable mixing zone for a substance that exceeds the acute criterion is the least of the following:

- 5 percent of the cross-sectional area of the receiving water body;
- 10 percent of the radial distance of the allowable mixing zone for the chronic criteria;
- 50 times the square root of the cross-sectional area of the discharge pipe; or
- 5 times the water depth.

For the Dorchester power plant discharge point, the third criterion would be the most limiting factor. Since the discharge pipe is 8 inches in diameter, a 30-foot mixing zone would be allowed. Using the worst-case results of the CORMIX1 mixing zone model and the required minimum daily average 1-hour tidal velocity value (0.22 fps) shows that the copper and chromium concentrations will drop below the acute criteria within 5 feet of the discharge, well within the allowable 30-foot mixing zone.

Five parameters (lead, mercury, copper, chromium, and selenium) are projected to be above the chronic toxicity water quality criteria (Table 4-14) in the discharge from the cooling tower. The worst-case mixing zone model results (a dilution ratio of only 5:1) indicate that all of these constituents would be within the chronic toxicity water quality criteria within a 50-foot mixing zone, the smallest mixing zone allowed under COMAR 26.08.02.05 for chronic criteria.

Delmarva Power used three cycles of cooling tower concentration to evaluate the compliance of the discharge with water quality standards. However, when the quality of the Nanticoke River water permits (lower ion and solids concentrations), the CPCN requires that Delmarva Power use up to six cycles of concentration. Under this circumstance, the intake volume would be reduced to a maximum daily withdrawal of 4.8 MGD (3310 gpm), and the blowdown volume to an estimated 0.8 MGD (561 gpm). The chemical constituent concentrations listed in Table 4-14 will remain within these values since the river values on which they are based will also be lower when more cycles are used. Both the chemical

concentrations and water temperature will be lower at the edge of the mixing zone with six cycles instead of three.

Other Constituents

Discharge concentrations of chlorine, DO, turbidity, pH, and total coliforms will be within the limits required by state water quality standards. Biocide used to maintain the cooling tower will not be discharged in amounts greater than the standard (0.2 mg/l monthly average and 0.5 mg/l daily maximum chlorine); allowing for some decay within the discharge pipe, values at the end of the pipe will be further reduced from the effluent standards. Aeration within the cooling tower will maintain DO well above the 5.0 mg/l daily minimum value.

Nutrient Loadings

There are no specific standards for nutrient loadings, but they should be kept to a minimum to reduce eutrophication within the Chesapeake Bay (COMAR 26.08.03.02B(3)). The bulk of the nitrogen and phosphorus in the cooling tower blowdown discharged to the Nanticoke River will come from the cooling water withdrawn from the Nanticoke River. The discharge of this component of the cooling tower blowdown back to the Nanticoke River, therefore, will not increase net loadings to the river. Although Delmarva Power's application originally included a cooling tower treatment additive (organic phosphanate) that would have contributed additional phosphorus, this was later eliminated (Delmarva Power, 22 April 1994 errata). The only source of net nutrient loadings will be the treated wastewater discharge component of the cooling tower blowdown. Nutrient loadings will be limited to about 0.12 kg/day of phosphorus and 0.057 kg/day of ammonia nitrogen.

## *Table 4-14 Chemical Mixing Zone—Case 1*

| | | | | Water Quality Criteria | | |
|---|---|---|---|---|---|---|
| Parameter | Units | End of Pipe Concentration | Ambient Concentration | Acute | Chronic | Concentration 50 feet from Outfall |
| Calcium | mg/l as $CaCO_3$ | 178 | 22 | | | 48 |
| Magnesium | mg/l | 167 | 57 | | | 75 |
| Sodium | mg/l | 1,377 | 450 | | | 604 |
| Iron | mg/l | 0.48 | 0.16 | | | 0.21 |
| Total cations | mg/l as $CaCO_3$ | 3,869 | 1,270 | | | 1,703 |
| Alkalinity | mg/l as $CaCO_3$ | 72 | 24 | | | 32 |
| Sulfate | mg/l | 425 | 135 | | | 183 |
| Chloride | mg/l | 2,374 | 800 | | | 1,062 |
| Nitrate | mg/l | 12 | 4 | | | 5 |
| Total anions | mg/l as $CaCO_3$ | 3,869 | 1,270 | | | 1,703 |
| Aluminum | mg/l | 2.61 | 0.88 | | | 1.17 |
| Arsenic | mg/l | 0.01 | | 0.36 | 0.19 | 0.002 |
| Barium | mg/l | 0.21 | 0.07 | | | 0.09 |
| Beryllium | mg/l | 0.01 | | | | 0.0017 |
| Cadmium | mg/l | 0.0004 | 0.00 | 0.0039 | 0.0011 | 0.0001 |
| Chromium | mg/l | 0.05 | | 0.016 | 0.011 | 0.0083 |
| Copper | mg/l | 0.025[a] | 0.006 | 0.018 | 0.012 | 0.009 |
| Lead | mg/l | 0.006 | 0.002 | 0.082 | 0.0032 | 0.003 |
| Manganese | mg/l | 0.02 | | | | 0.0037 |
| Mercury | mg/l | 0.00002 | 0.00 | 0.0024 | 0.000012 | 0.000003 |
| Nickel | mg/l | 0.023[b] | 0.006 | 1.4 | 0.16 | 0.009 |
| Potassium | mg/l | 0.50 | | | | 0.083 |
| Selenium | mg/l | 0.009 | 0.003 | 0.02 | 0.005 | 0.004 |
| Titanium | mg/l | 0.01 | | | | 0.002 |
| Vanadium | mg/l | 0.04 | | | | 0.007 |
| Zinc | mg/l | 0.109 | 0.028 | 0.12 | 0.11 | 0.042 |
| Silica | mg/l as $SiO_2$ | 15 | 5 | | | 6 |
| Carbon dioxide | mg/l as $CO_2$ | 8 | 0 | | | 1 |
| Total dissolved solids | mg/l | 4518 | 1,460 | | | 1,970 |
| Chemical oxygen demand | mg/l | 40 | 19 | | | 22 |

## Table 4-14 Chemical Mixing Zone —Case 1 (Continued)

| Parameter | Units | End of Pipe Concentration | Ambient Concen-tration | Water Quality Criteria Acute | Water Quality Criteria Chronic | Concentra-tion 50 feet from Outfall |
|---|---|---|---|---|---|---|
| Total organic carbon | mg/l | 29 | 10 | | | 13 |
| Total suspended solids | mg/l | 255 | 86 | | | 114 |
| Turbidity | NTU | 130 | 44 | ≤150 | ≤150 | 58 |
| Kjeldahl nitrogen | mg/l as N | 8 | 3 | | | 4 |
| Oil and grease | mg/l | 15 | 1 | | | 4 |
| Total coliform | per 100 ml | 0.009 | 9 | <200 | <200 | 8 |
| Ammonia | mg/l as $NH_3$ | 0.27 | 0.092 | | | 0.12 |
| Total phosphorus | mg/l as P | 1.81 | 0.061 | | | 0.35 |
| pH | | 6-9 | 6.8 | >6.5and <8.5 | >6.5 and <8.5 | 6.8 |
| BOD | mg/l | 0.62 | 0.9 | | | 0.9 |
| Free residual chlorine | | (c) | | | | |

NOTE: Dilution ratio at 50 feet from the outfall is 5.0 for Vienna.
(a) Including 0.00735 mg/l of additional copper due to corrosion.
(b) Including 0.00315 mg/l of additional nickel due to corrosion.
(c) Less than 0.2 mg/l as a monthly average and 0.5 mg/l as a daily maximum.

Source: Delmarva Power Phase II CPCN Application, 1993, (Table 5.1.2-3).

The projected nutrient loadings represent an extremely small percentage of total loadings to the Nanticoke River above Vienna; total phosphorus loadings from one unit will be about 0.06 percent and total nitrogen loadings will be about 0.0012 percent of total loadings to the upper Nanticoke River. (Total loadings to the Nanticoke River were estimated by using the average river concentrations presented by MDE (1993). Average total phosphorus and total nitrogen concentrations were 0.1 mg/l and 2.5 mg/l, respectively. Average freshwater inflow above Vienna is 810 cfs. Total phosphorus and nitrogen loadings using these values are 198 kg/day and 4950 kg/day, respectively).

### 4.2.2.4 *Coal Delivery System*

Coal will be delivered to the Dorchester power plant by rail or barge. The waves and currents generated by barge traffic on the Nanticoke River are the primary potential surface water impacts from delivery of coal to the site. Delmarva Power estimated that the waves generated by barge traffic would have a maximum height of 0.6 feet when they reached the shoreline. If all of the coal was delivered by barge, waves from barge traffic would occur for approximately 2 minutes per day along a particular portion of shoreline. Barges could generate currents of 1.65 fps up to twice per day for short durations; in comparison, tidal current velocity is about 2 fps for a duration of about 1 hour per tide. Barge traffic is not likely to substantially affect water quality in the Nanticoke River.

## 4.3 *POTENTIAL GROUND WATER IMPACTS*

Construction and operation of Dorchester Unit 1 at the Dorchester site will require withdrawal of ground water from the underlying Columbia Aquifer. Delmarva Power proposed pumping ground water from two production wells (PW-1 and a second well proposed about 300 feet west of PW-1). PPRP evaluated the following potential ground water impacts from the proposed ground water withdrawal.

- *Reduction in Available Drawdown*—Ground water withdrawal could result in permanent ground water level declines (drawdown) in the aquifer.
- *Wetlands Dewatering*--Wetlands dewatering could occur under conditions of excessive drawdown by lowering the ground water table in these areas.
- *Brackish Water Intrusion*—Altered flow directions could result in ground water quality impacts by inducing brackish water intrusion into the Columbia Aquifer from neighboring tidal creeks and rivers.
- *Land Subsidence*—Land subsidence may occur if excessive ground water withdrawals result in aquifer compaction that is propagated to the land surface. The phrase "aquifer compaction" refers to the compaction of sediments that comprise the aquifer. If the magnitude is sufficient, land subsidence may cause failure of surface structures and buckling of underground lines.

PPRP evaluated the potential for and magnitude of these four impacts related to construction and operation ground water withdrawals by projecting the response of the Columbia Aquifer to several pumping scenarios using analytical solutions (Table 4-15). All pumping was assumed to be from existing well PW-1. Transmissivity and storativity values of 163,400 gpd/ft and 0.2 (dimensionless), respectively, were used as aquifer parameters. The Columbia Aquifer was assumed to be homogeneous, uniformly thick and infinite in areal extent (conditions that are consistent with observations made during field investigations and aquifer pump testing).

*Table 4-15 Summary of Simulated Pumping Scenarios for the Dorchester Site*

| Simulated Pumping Scenario | Simulated Flow Rate (gpm) | Simulated Duration | Projected Results/Comments for Each Pumping Scenario |
|---|---|---|---|
| Construction Dewatering | 9,000<br>6,250<br>700 | 1 months<br>5 months<br>17 months | • Maximum drawdown projected at end of 6 months 5 to 15 feet off-site;<br>• Drawdown could lower water levels below an off-site 20 foot deep domestic well or reduce three irrigation well yields by 100 gpm to 400 gpm; and<br>• Low potential for wetlands dewatering, brackish water intrusion or land subsidence. |
| Short-term Withdrawal For Dorchester 1 | 260<br>500 | 1 year<br>1 month | • Maximum off-site projected drawdowns are 1.5 feet or less; and<br>• Low potential for significant reduction in available drawdown to other users, wetlands dewatering brackish water intrusion or land subsidence. |
| Long-term Withdrawal For Dorchester 1 | 260<br>500 | 30 years<br>1 month | • Maximum off-site projected drawdowns are 2 feet or less; and<br>• Low potential for significant reduction in available drawdown to other users, wetlands dewatering brackish water intrusion or land subsidence. |
| Short-term Withdrawal For Dorchester 1 & 2 | 520<br>1,000 | 1 year,<br>1 month | • Maximum off-site projected drawdowns are 2.5 feet or less; and<br>• Low potential for significant reduction in available drawdown to other users, wetlands dewatering brackish water intrusion or land subsidence. |
| Long-term Withdrawal For Dorchester 1 & 2 | 520<br>1,000 | 30 years<br>1 month | • Maximum off-site projected drawdowns are 4 feet or less; and<br>• Low potential for significant reduction in available drawdown to other users, wetlands dewatering brackish water intrusion or land subsidence |

Leachate generated from coal storage piles and coal combustion by-product landfills present the greatest risks to ground water quality at the Dorchester site. Potential impacts to ground water quality may affect its use for domestic and municipal potable water supply systems, as well as for irrigation and industrial purposes.

PPRP evaluated potential ground water quality impacts from plant operations by modeling simulation of several conservative scenarios, each of which involved the release of leachate to the Columbia Aquifer from either the landfill or coal piles. The simulations projected ground water concentrations at hypothetical receptors. The projected concentrations were then compared to drinking water standards and ambient water quality criteria to assess potential exposure to human health and ecological receptors, respectively. The following sections present the results of this evaluation.

### 4.3.1 *Construction Dewatering*

Delmarva Power identified the need to remove ground water (dewater), during construction of several facility components within the power block area. Delmarva Power's CPCN application included a completed ground water appropriations application for construction dewatering. This ground water appropriations request specified a yearly average withdrawal of 9,000,000 gpd (6,250 gpm), and a withdrawal of 10,800,000 gpd (7,500 gpm) during the month of maximum use. Construction dewatering would continue for about 2 years. In response to DNR Data Request No. 1, Delmarva Power stated that the dewatering rates provided in the CPCN application were based on a very conservative dewatering schedule. In actuality, Delmarva Power expected the maximum withdrawal rate for construction dewatering to be on the order of 3,600 gpm during the month of maximum use, and 1,700 gpm for the yearly average (Delmarva Power, Response to DNR Data Request Number 3, Question 3, 1994).

#### 4.3.1.1 *Potential Ground Water Quantity Impacts Resulting from Ground Water Withdrawal for Construction Dewatering*

Construction dewatering Scenario 1 simulated the following dewatering schedule proposed by Delmarva Power in the CPCN application: 9,000 gpm for 1 month; 6,250 gpm for an additional 5 months; followed by 700 gpm for an additional 17 months (Table 4-15). The simulated withdrawals were assumed to take place continuously over the 23 month schedule. Aquifer drawdown due to pumping was estimated using the Theis method (1945) for determining aquifer response to a well pumping at a constant rate, combined with the Jacobs (1940) correction for drawdown in a water table aquifer.

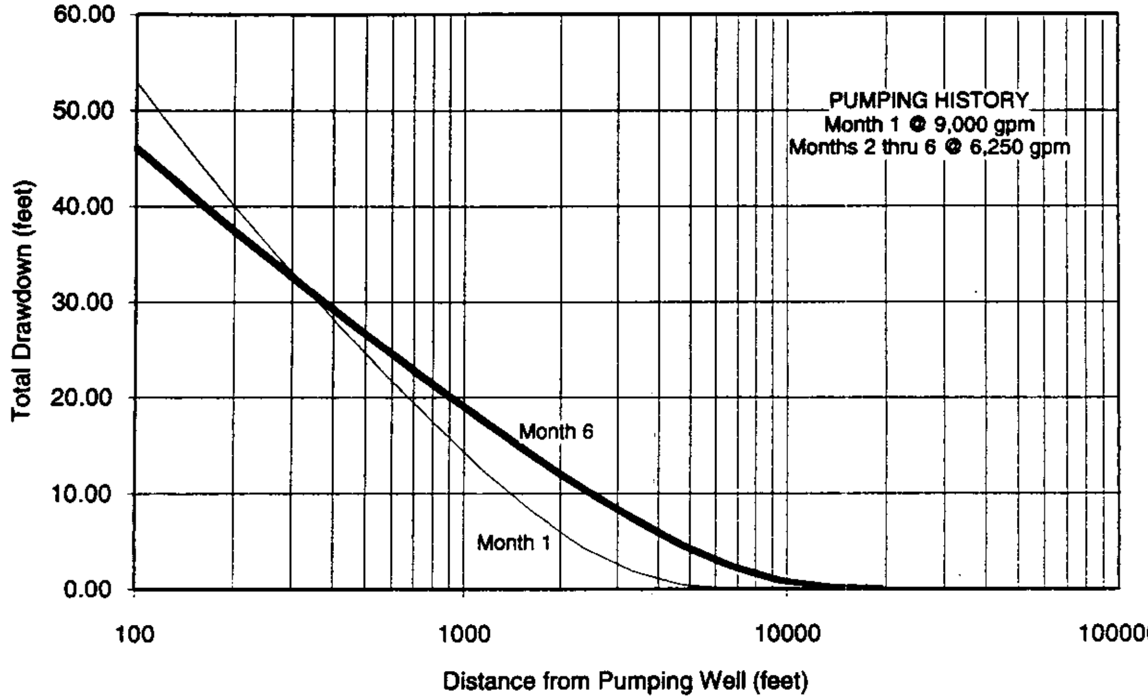
Figures 4-3A and 4-3B present the projected distance-drawdown relationship during construction dewatering. At the end of 23 months of continuous dewatering (reflecting a maximum withdrawal of 7,500 gpm for the first month of construction, then a withdrawal of 6,250 gpm for construction months 2 through 6, and a decrease to 500 gpm for construction months 6 through 23), the projected drawdown values range from about 1.5 feet to 4 feet at 1,000 to 10,000 feet from the pumping well. The maximum projected drawdown of 15 feet, at a distance of 1,000 feet from the pumping well, occurs after the first month of construction and maximum dewatering rate. After 6 months of pumping, drawdown is projected to increase to 20 feet. As dewatering rates decrease significantly, the aquifer recovers (water levels rise) during months 7 through 23.

# Figure 4-3A

## Distance-Drawdown Analysis

### Scenario 1 - Construction Dewatering

### Months 1 and 6

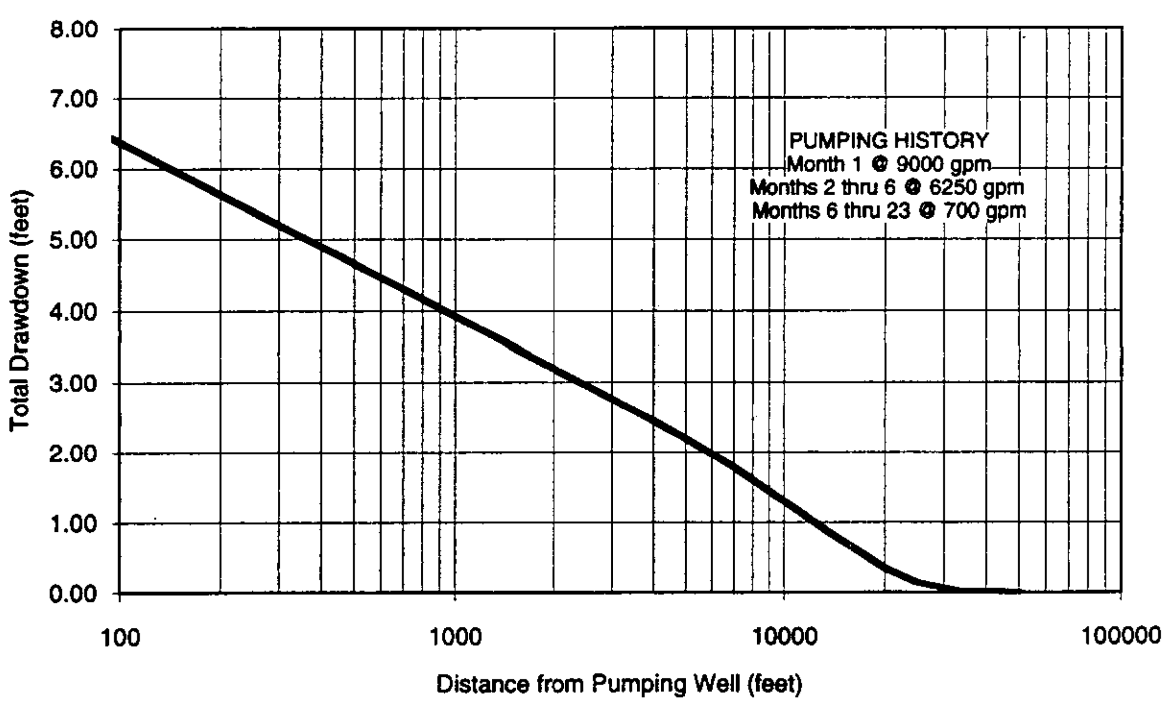



# Figure 4-3B

## Distance-Drawdown Analysis

### Scenario 2 - Construction Dewatering

### Month 23




**Aquifer Parameters**

T = 160,820 gpd/ft

S = 0.2

Note: Water table correction for drawdown: $s' \sim s + s^*s/2b$

Figure 4-4 presents a contour map of drawdown projected at the end of the first 6 month period.

The following sections provide a brief evaluation of the potential for construction dewatering to reduce available drawdown, dewater wetlands, affect brackish water intrusion, and cause subsidence. Rafalko and Keating (1993) presents a detailed discussion of the methods and results of this evaluation.

#### Potential for Reducing Available Drawdown

PPRP's evaluation indicated the potential for significant declines in water levels (20 feet, at 1,000 feet from the pumping well), at the end of the first 6 months of dewatering. This amount of drawdown, while substantial, may be inconsequential considering the Columbia Aquifer's 70 to 90 foot saturated thickness in the site vicinity. Therefore, the aquifer will not be adversely affected by this short-term withdrawal.

Delmarva Power's well inventory (1993) shows that two shallow domestic wells fall between the 5 and 10-foot drawdown contours (shallow domestic wells 10 and 25 in Figure 3-4). Domestic well 10 is about 20 feet deep, while well 25 is about 90 feet deep. The projected drawdown in the vicinity of well 10 suggests that the water level could be lowered below the pump intake.

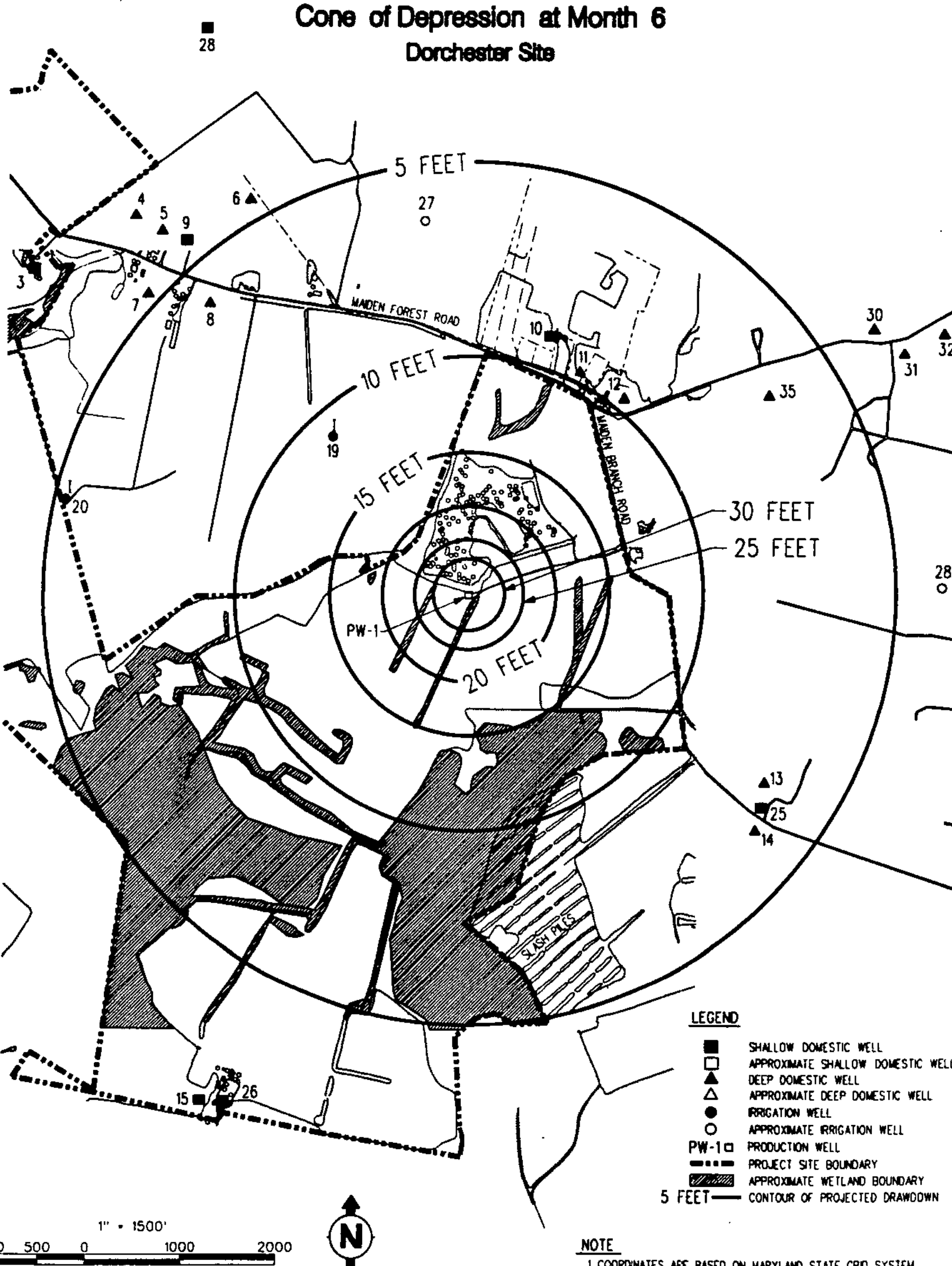
A reduction of 5 to 15 feet of available drawdown is projected for distances coincident with the location of three irrigation wells (irrigation wells 19, 20 and 27 in Figure 3-4). If dewatering occurs during the summer growing season, and the projected drawdowns occur, the loss of well yields at the irrigation wells could be about 100 gpm to 400 gpm.

#### Potential for Dewatering Wetlands

The potential for construction dewatering to adversely impact wetlands is low for the following reasons.

- The low permeability of the Surficial Leaky Aquitard is resposible for the occurrence of wetland hydrology observed on the site. This aquitard will continue to cause ponding of precipitation, maintaining hydric soil conditions.
- The aquitard's low permeability will significantly limit the rates and magnitude of vertical leakage.
- Construction dewatering is only a temporary condition, and will not be continuous. Breaks in dewatering activities will provide periods for recharging wetlands.

# Figure 4-4
## Scenario 1
## Construction Dewatering
## Cone of Depression at Month 6
## Dorchester Site

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#### Potential for Brackish Water Intrusion

The potential for brackish water intrusion is low. At distances coincident with Chicamacomico River, Chicone Creek and the Nanticoke River, projected drawdown is about 2 feet or less.

#### Potential for Land Subsidence

The potential for land subsidence is low under current site conditions. For a drawdown of 15 feet (the maximum off-site drawdown projected by the simulations), theoretical calculations using an analytical solution presented in Freeze and Cherry (1979), and presented in Rafalko and Keating (1993), estimate a potential subsidence of about 0.02 inches. Subsidence can be estimated from the following equation:

$$db = (-a) \times (b) \times (pg) \times (dh), \text{ where}$$

*db* is land subsidence (feet); *a* is the compressibility of the aquifer (assumed to be $2.1 \times 10^{-8}$ $ft^2$/pound); *b* is the aquifer thickness (assumed to be 80 feet); *pg* is the weight density of water (62.4 pounds/$ft^3$), and *dh* is the projected drawdown (feet).

### 4.3.1.2 *Potential Ground Water Quality Impacts Related to Construction Dewatering*

Delmarva Power proposed using detention ponds for erosion and sediment control measures. The detention ponds will collect stormwater runoff during construction, and ground water from dewatering activities. The water in the detention ponds could evaporate, infiltrate into the Columbia Aquifer or discharge into Chicamacomico River following site drainage patterns.

The use of detention ponds and subsequent infiltration of dewatering effluent into the Columbia Aquifer will not create any adverse impacts to ground water quality for the following reasons. First, ground water pumped for dewatering will pass through silt screens to remove suspended solids. Suspended solids will also be removed naturally as the water infiltrates through the underlying sediments. Second, any water that may infiltrate into the Columbia Aquifer would originate from either precipitation, which should not contain high concentrations of dissolved constituents, or the Columbia Aquifer, which is being dewatered.

### 4.3.2 *Power Plant Operation*

#### 4.3.2.1 *Potential Ground Water Quantity Impacts Resulting from Ground Water Withdrawal During Operation of Dorchester Unit 1*

Delmarva Power proposed using an average of 374,400 gallons per day (260 gpm) of ground water to supply process and service water needs, including boiler makeup and air emissions controls. Under maximum use conditions associated with the month of initial start-up, average daily withdrawal will be limited to 720,000 gallons (500 gpm). Table 4-15 summarized the pumping scenarios simulated to evaluate potential impacts that could result from ground water withdrawal. The simulations used the same modeling approach as described previously for construction dewatering.

Short-term and long-term drawdowns were projected to range from about 1.5 to 2 feet at a distance of about 1,000 feet from PW-1. The projected drawdown represents about 2.5 percent of the available drawdown in the Columbia Aquifer. The greatest drawdowns, and therefore, the greatest potential for ground water impacts are associated with the long-term pumping simulated under Scenario 3. Figure 4-5 presents a contour map of drawdown projected at the end of 30 years for Scenario 3.

The following sections provide a brief evaluation of the potential for pumping ground water during plant operation to reduce available drawdown, dewater wetlands, cause brackish water intrusion and subsidence. Rafalko and Keating (1993) provides a detailed discussion of the methods and results of this evaluation.

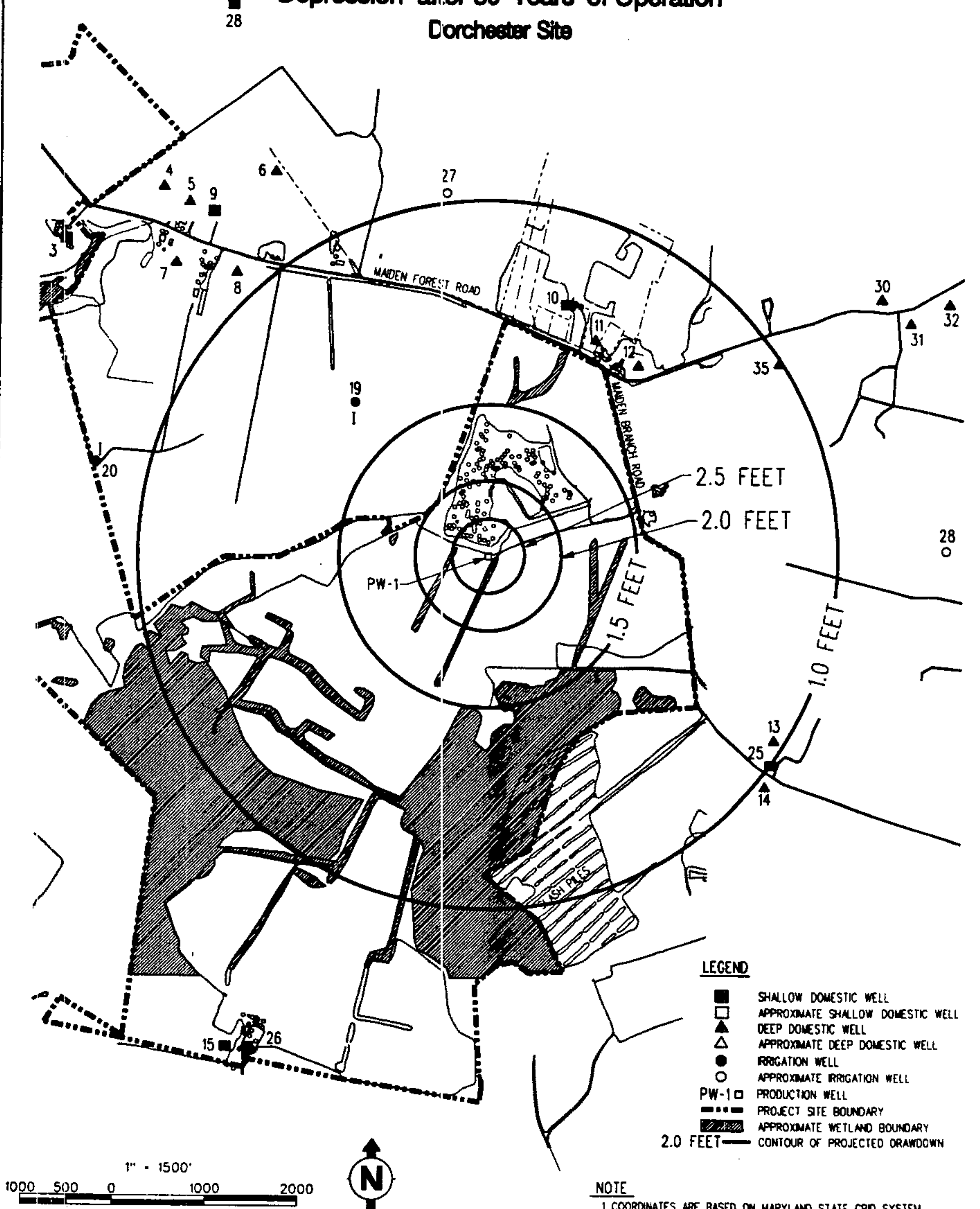
**Potential for Reducing Available Drawdown**

The results of PPRP's evaluation indicate that neither short-term or long-term pumping conditions will significantly reduce available drawdown to other ground water users. The projected maximum reduction in available drawdown is only about 2.5 percent of the saturated thickness of the Columbia Aquifer. Water levels are unlikely to be lowered below any well intakes identified in Delmarva Power's (1993) well inventory.

**Potential for Wetlands Dewatering**

PPRP's evaluation indicates that neither short-term or long-term pumping will significantly impact wetlands. Few wetlands exist in the power block, where the plant withdrawals will occur, instead, the majority of the wetlands are about 1,500 feet from the pumping well. At this distance, only about 1.5 feet of drawdown are projected in the Columbia Aquifer after 30 years of continuous pumping (Scenario 3). Furthermore, the

# Figure 4-5
## Scenario 3
## Operation of Dorchester 1 Cone of Depression after 30 Years of Operation
### Dorchester Site

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presence of the Surficial Leaky Aquitard will impede infiltration, resulting in ground surface ponding. The fine grained sediments of the aquitard should significantly limit the release of water from storage in the aquitard, resulting in minimal reduction in volumetric water content and persistent hydric conditions.

**Potential for Brackish Water Intrusion**

Long-term pumping will not produce significant brackish water intrusion. At distances coincident with the Chicamacomico River, Chicone Creek and the Nanticoke River, projected drawdown is about 0.8 feet or less.

**Potential for Land Subsidence**

PPRP's evaluation indicates ground water withdrawal will cause minimal land subsidence within the vicinity of the site. As stated for Scenario 1 (construction dewatering), only about 0.02 inches of subsidence is projected for a drawdown of 15 feet. The projected drawdowns for Scenarios 2 and 3 are much less than those for Scenario 1.

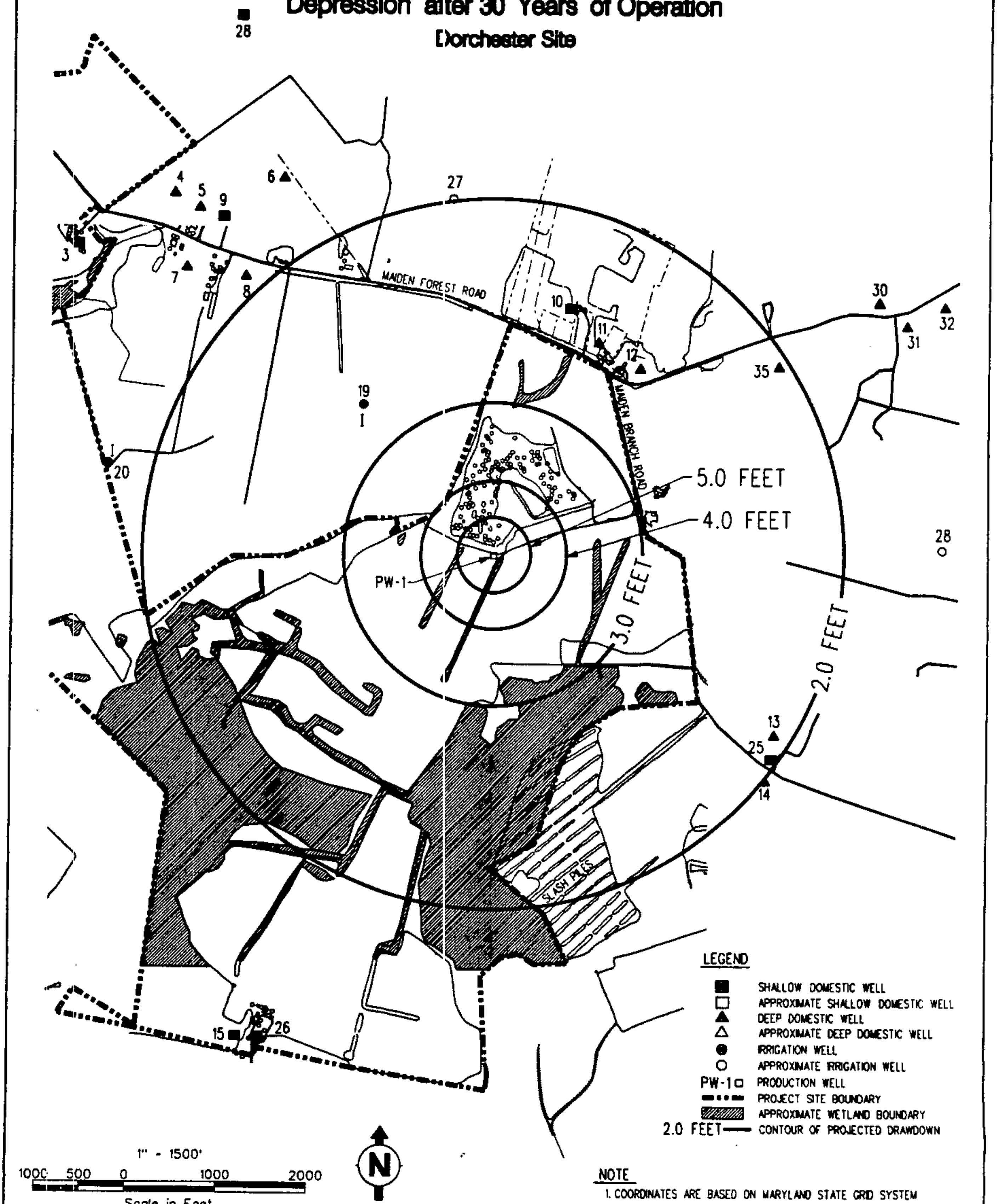
4.3.2.2 *Potential Ground Water Quantity Impacts Resulting from Ground Water Withdrawal During Operation of Dorchester Units 1 and 2*

Simulated pumping Scenarios 4 and 5 evaluated ground water withdrawal for the concurrent operation of Dorchester Unit 1 and a future Unit 2. Table 4-15 summarized the details and results of each scenario. The simulations used the same modeling approach as described previously for construction dewatering.

Projected short-term and long-term drawdowns ranged from about 2.5 to 4 feet at a distance of about 1,000 feet from PW-1. The projected drawdown represents about 5 percent of the available drawdown in the Columbia Aquifer. The greatest drawdowns, and therefore, the greatest potential for ground water impacts, are associated with the long-term pumping simulated under Scenario 5. Figure 4-6 presents a contour map of drawdown projected at the end of 30 years for Scenario 5.

The following sections present a brief evaluation of the potential for ground water pumping during operation of Dorchester Units 1 and 2 to reduce available drawdown, dewater wetlands, and cause brackish water intrusion and subsidence. Rafalko and Keating (1993) presents a detailed discussion of the methods and results of this evaluation.

# Figure 4-6
## Scenario 5
## Operation of Dorchester 1 & 2 Cone of Depression after 30 Years of Operation
### Dorchester Site

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#### Potential for Reducting Available Drawdown

Withdrawing ground water to operate two units at the Dorchester site will have little impact on the drawdown available to other users. Long-term pumping will result in a projected maximum reduction of only 5 percent of the saturated thickness. Water levels are unlikely to be lowered below any well intakes identified in Delmarva Power's (1993) well inventory.

#### Potential for DewateringWetlands

Long-term pumping to operate two units at the Dorchester site will not dewater wetlands, on the basis of the reasons stated previously for Scenarios 2 and 3.

#### Potential for Brackish Water Intrusion

Long-term ground water pumping to support the operation of two units on the Dorchester site has little potential for causing brackish water intrusion. Projected drawdown is about 2 feet or less at distances coincident with Chicamacomico River, Chicone Creek and the Nanticoke River.

#### Potential for Land Subsidence

Withdrawing ground water to operate two units on the Dorchester site will cause minimal land subsidence within the vicinity of the site. As stated for Scenario 1, only about 0.02 inches of subsidence is projected for a drawdown of 15 feet. The projected drawdowns for this scenario are much less than those for Scenario 1.

### 4.3.2.3 *Ground Water Quality Impacts During Plant Operation*

On-site disposal of coal combustion by-products, storage of active and inactive coal piles, on-site handling and storage of petroleum products, and low-volume utility waste are the primary plant operation activities with the potential for affecting ground water quality. PPRP focused its evaluation of potential ground water quality impacts caused by the operation of Dorchester Unit 1 on the two most likely causes: on-site disposal of coal combustion by-products, and storage of active and inactive coal piles. The following sections summarize the results of this evaluation. Rafalko and Keating (1993) provides a detailed description of this evaluation.

Delmarva Power proposed landfilling commingled coal combustion by-products from Unit 1 in the on-site lined, non-hazardous industrial waste landfill, Waste Disposal Area 1. Waste Disposal Area 2 will only be developed if additional capacity is needed (Figure 4-7).

Table 4-16 presents a summary of representative leachate quality derived from the literature, for the commingled fly ash and FGD waste collected from the SDA, and coal pile runoff. Leachate generated from these sources may contain high levels of major cations and anions and trace levels of heavy metals. The pH of the landfill leachate would be high (basic) and the pH of the leachate from the coal piles would be low (acidic) relative to ground water conditions.

In the event that leachate is released to the aquifer, potential impacts include the following.

- *Domestic Water Supply*—Potable water supplies to domestic and municipal systems could be impaired by poor ground water quality. The potential for this impact is low for two reasons: 1) the low number of supply wells downgradient of the site; and 2) the majority of the domestic wells in the site vicinity do not obtain ground water from the Columbia Aquifer but from deeper aquifers less likely to be contaminated from activities associated with the Dorchester Unit 1 facility.
- *Irrigation Water Supply*—Degradation of ground water quality could affect its use for irrigation.
- *Surface Water Quality*—Water quality of the Chicamacomico River and its tributaries could be affected by the discharge of ground water contaminated by the accidental release of leachate.

PPRP developed several conservative or "worst-case" leachate release scenarios, and identified potential receptors to assess potential ground water quality impacts. For each scenario, analytical solute transport and mixing models were used to project ground water quality (Rafalko and Keating 1993). The projected concentrations were then compared to drinking water standards for human health exposure scenarios and water quality criteria for ecological receptors.

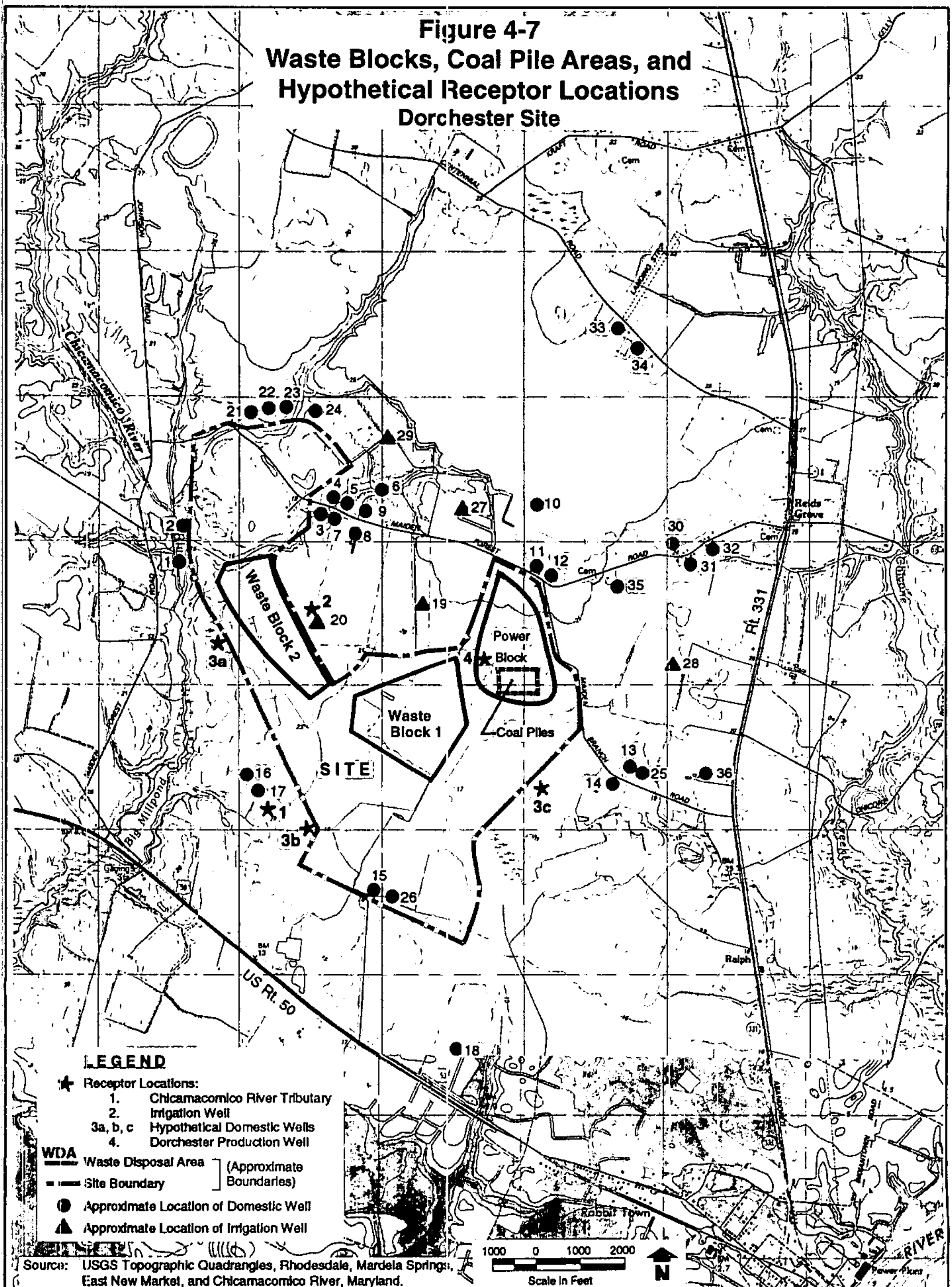


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*Table 4-16 Literature Values for Spray Dryer Waste and Coal Pile Leachate*

| Constituent (mg/l) | Spray Dryer Waste Leachate Range | | | Coal Pile Runoff Leachate Range | | Drinking Water Standards MCLs and SMCLs | Federal Aquatic Water Quality Criteria | | Maryland Toxic Substances Criteria Ambient Surface Waters | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low | High | Ref. | Low | High | MCLs and SMCLs | Chronic | Acute | Chronic | Acute |
| pH units | 9.8 | 12.1 | k | 2.1 | 9.3 | 6.5 to 8.5 (S) | 6.5 | 6.9 | | |
| Alkalinity* | 952 | 3430 | e | 300 | 7100 | | ≥20 | | | |
| TDS | 3230 | 9980 | e | 270 | 28970 | 500 (M) | 500 | | | |
| TSS | | | | 8 | 2500 | | | | | |
| Aluminum | | | | 20 | 1200 | 0.05 to 0.2 (S,T) | 0.087 | 0.75 | | |
| Ammonia | | | | ND | 1.8 | | | | | |
| Arsenic | 0.005 | 0.04 | e | 0.005 | 0.6 | 0.05 (M) | 0.19 | 0.36 | 0.19 | 0.36 |
| Barium | 0.1 | 1.5 | k | | | 2 (M) | | | | |
| Beryllium | | | | 0.01 | 0.07 | 0.004 | | | | |
| Cadmium | 0.015 | 0.031 | e | 0.001 | 0.003 | 0.005 (M) | 0.0011 | 0.0039 | 0.0039 | 0.0011 |
| Chloride | 18 | 330 | k | 3.6 | 481 | 250 (S) | 230 | 860 | | |
| Chromium | 0.12 | 0.51 | k | 0.005 | 16 | 0.1 (M) | 0.21 | 1.7 | | |
| Cobalt | | | | 0.025 | | | | | | |
| Copper | 0.007 | 0.18 | k | 0.01 | 6.1 | 1.3 (T) | 0.012 | 0.018 | 0.12 | 0.18 |
| Fluoride | 1.7 | 4.9 | e | | | 4 (M) | | | | |
| Iron | <0.001 | <0.25 | k | 0.1 | 5250 | 0.3 (S) | 1 | | | |
| Lead | <0.001 | 0.01 | e | | | 0.015 (T) | 0.0032 | 0.082 | 0.082 | 0.0032 |
| Magnesium | | | | ND | 174 | | | | | |
| Manganese | 0.002 | 0.22 | k | 0.9 | 180 | 0.05 (S) | | | | |
| Mercury | <0.001 | <0.001 | e | 0.0002 | 0.007 | 0.002 (M) | 0.00012 | 0.0024 | 0.00012 | 0.0024 |
| Nickel | | | | 0.1 | 4.5 | | 0.16 | 1.4 | 0.16 | 1.40 |
| Nitrate | 10 | 200 | k | 0.3 | 1.9 | 10 (M) | | | | |
| Nitrite | <2 | 160 | k | | | 1 (M) | | | | |
| Phosphorous | | | | 0.2 | 1.2 | | | | | |
| Selenium | 0.025 | 0.01 | e | 0.001 | 0.03 | 0.05 | 0.005 | 0.02 | 0.005 | 0.02 |
| Silver | 0.009 | 0.37 | k | | | 0.1 (S) | | 0.0041 | 0.00012 | 0.0041 |
| Sodium | | | | 160 | 1260 | | | | | |
| Sulfate | 1100 | 4200 | e | 130 | 20000 | 250 (S) | 250 | | | |
| Sulfite | 2 | 111 | e | | | | | | | |
| Zinc | <0.003 | 0.22 | k | 0.006 | 26 | 5 (S) | 0.11 | 0.12 | 0.11 | 0.12 |

**Notes** Blank fields indicate no data or no standard on this parameter
Concentrations in mg/l except for pH;
*Alkalinity expressed as calcium carbonate equivalent
**1. References for Leachate Quality**
k - Klimek *et al.* 1987 - ASTM Leachate Analysis
e - EPRI Management of Solid By-Products From Advanced $SO_2$ Control Systems CS-5076 April 1987
Coal Pile Leachate - USEPA Waste from the Combustion of Coal by Electric Utility Power Plants EPA/530-SW-88-002 Feb 1988
**2. Notes on Regulatory Standards**
M- Primary Drinking Water Standards (MCLs); S - Secondary MCLs
T - Action levels at tap
Maryland Toxic Substance Criteria - COMAR 26.08.02.03-2

Figure 4-8 schematically illustrates the release of leachate into the Columbia Aquifer. The underlying assumptions of each scenario are listed below.

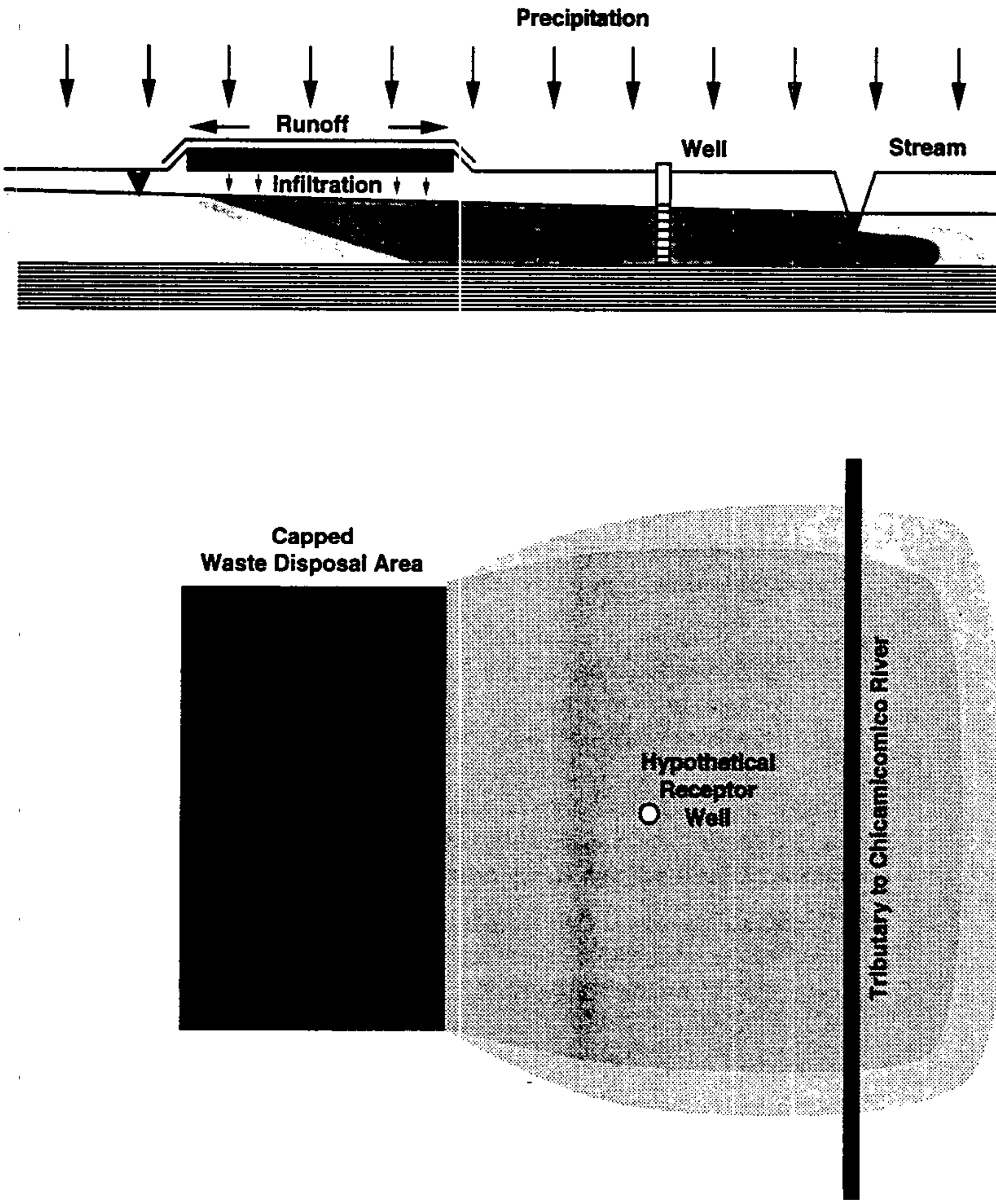
- Leachate is generated by the infiltration of precipitation through the landfills or coal piles.
- Leachate is accidentally released to the unsaturated zone.
- Leachate infiltrates into the Columbia Aquifer from the unsaturated zone. Once in the ground water flow system, leachate migrates with the ground water flow direction through the processes of advection and dispersion (i.e., mixing of leachate with clean ground water). Chemical processes which potentially could reduce the peak concentrations in the aquifer were not simulated, adding a level of conservatism to the evaluation.

The results of mixing leachate with clean ground water through advection and dispersion were represented by a dilution factor for each potential receptor. The dilution factor represents the ratio of the leachate source concentration to the concentration realized at the potential downgradient receptor. For example, if mixing of leachate with an initial concentration of 200 milligrams per liter (mg/l) of nitrate and clean ground water results in a concentration at a downgradient receptor of 20 mg/l, the dilution factor is 10 (i.e., source concentration of 200 mg/l divided by the receptor concentration of 20 mg/l).

The dilution factor is a useful parameter because it can be used to determine the source concentration needed to exceed water quality standards at a receptor. Using the example above, the drinking water standard for nitrate is 10 mg/l. The source concentration needed to exceed the standard at the receptor location can be estimated by multiplying the water quality standard by the dilution factor. In this case 10 times 10 mg/l results in a source strength of 100 mg/l or more needed to exceed the drinking water standard. For this example, the leachate concentration was 200 mg/l, indicating that the leachate is of sufficient concentration to exceed the drinking standard of 10 mg/l of nitrate at the receptor. As shown below, the dilution factors determined through the analytical simulations were used to evaluate the potential adverse impacts to ground water quality.

PPRP generated aquifer dilution factors for six feasible and conservative leachate release scenarios that represent worst case failures in the by-product disposal facilities and coal pile storage area. The simulated scenarios are summarized below, followed by a summary of the potential receptors.

## Figure 4-8
## Chronic Release of Leachate from a Waste Disposal Area



Release Scenarios for Waste Disposal and Coal Pile Storage Areas

- *Scenario No. 1—Chronic Release of Leachate from Waste Disposal Area 1 (WDA 1).* This scenario assumed that the liner and leachate collection system developed cracks and that leachate continuously leaked to the underlying aquifer. The chronic scenarios simulated releases for 30 years.
- *Scenario No. 2—Catastrophic Release of Leachate from Waste Disposal Area 1 (WDA 1).* This scenario assumed that the liner and/or leachate collection system ruptured and leachate was released as a slug to the underlying aquifer. The catastrophic scenarios simulated a one time leachate release.
- *Scenario No. 3—Chronic Release of Leachate from Waste Disposal Area 2 (WDA 2).* This scenario assumed that the liner and/or leachate collection system developed cracks and that leachate was continuously leaked to the underlying aquifer.
- *Scenario No. 4—Catastrophic Release of Leachate from Waste Disposal Area 2 (WDA 2).* This scenario assumed that the liner and/or leachate collection system ruptured and leachate was released as a slug to the underlying aquifer.
- *Scenario No. 5—Chronic Release of Leachate from the Coal Piles.* This scenario assumed that the liner under the coal pile storage area or stormwater retention basin developed cracks, and that coal pile leachate leaked to the underlying aquifer. This scenario assumed leakage for one year prior to repair of the liner.
- *Scenario No. 6—Catastrophic Release of Leachate from the Coal Piles.* This scenario assumed that the stormwater retention basin suffered a major rupture, and released a slug of leachate (stormwater runoff from the coal piles) to the aquifer.

Figure 4-7 presents locations for potential human and ecological receptors evaluated for each of the scenarios. Each potential receptor and the applicable release scenario are summarized below and in Table 4-17.

- *Potential Receptor 1, Tributary to the Chicamacomico River.* This receptor addressed potential surface water impacts. The receptor was assumed to be the nearest downgradient tributary to the Chicamacomico River where impacted ground water could discharge. Scenarios 1 and 2 evaluated potential impacts to this receptor.
- *Potential Receptor 2, Irrigation Well.* The irrigation well located along the eastern perimeter of Waste Disposal Area 2 (shown as well number 20 in Figure 3-4) was selected as a potential receptor because it is the closest irrigation well to the landfills. Scenarios 3 and 4 evaluated potential impacts to this receptor.

- *Potential Receptors 3A, 3B, and 3C, Potable Water at Site Perimeter.* To address potential impacts to ground water quality within the context of drinking water standards, hypothetical domestic wells were assumed to be completed in the Columbia Aquifer, and located downgradient of Waste Disposal Areas 1 and 2, and the coal piles (three separate locations at the property boundaries). All six scenarios evaluated potential impacts to these receptors.
- *Receptor 4, Dorchester 1 Production Well ((PW-1).* The production well for Dorchester Unit 1 (PW-1) was selected as a potential receptor to determine potential adverse impacts in ground water quality due to leachate release from the coal pile storage area. Adverse impacts to ground water quality could increase Delmarva Power's water treatment costs. Scenarios 5 and 6 evaluated potential impacts to this receptor. Because the waste disposal areas do not lie within the capture zone of the production well, impacts for these potential source areas were not simulated for this receptor.

Table 4-17 presents the dilution factors calculated for each simulated scenario and potential receptor. The lowest dilution factors are associated with the chronic releases; the plume created by a continuous release over a long period of time is diluted less than the slug of leachate from the catastrophic release (i.e., one-time release). Projected maximum concentrations were calculated for each scenario and receptor using the dilution factors in Table 4-17, and are presented in Tables 4-18 and 4-19. Maximum concentrations were projected (using the maximum values from the literature ranges) to add a measure of conservatism.

Projected concentrations resulting from the waste disposal area scenarios indicate that drinking water quality at the receptor locations is unlikely to be impaired. Most projected concentrations are orders of magnitude below the applicable drinking water standard. The only constituent projected to possibly exceed the Maximum Contaminant Level (MCL) is nitrite. The projected maximum concentrations for nitrite range from 2 to 4 mg/l, which exceed the MCL of 1 mg/l. The simulations project that Secondary Maximum Contaminant Levels (SMCLs) are not likely to be exceeded.

In actuality, the potential for nitrite levels to exceed MCLs at a receptor is unlikely, for the following three reasons.

- The projection was based on maximum levels reported in the literature. For nitrite, the lower end of the range is less than 2 mg/l, which would be diluted to insignificant levels.
- The simulation results did not account for any degradation of nitrite that would occur naturally.

- Both Waste Disposal Areas will be lined and a ground water monitoring program initiated to comply with COMAR. Good engineering practices should prevent nitrite levels above MCLs from reaching the site perimeters.

*Table 4-17 Calculated Dilution Factors for Simulated Leachate Release Scenarios*

| | Simulated Leachate Release Scenario | Potential Receptor | Dilution Factor |
|---|---|---|---|
| 1 | Chronic Release from Waste Disposal Area 1 | Receptor 3B, Hypothetical Potable Well | 43 |
| | | Receptor 1, Chicamacomico Tributary | 50 |
| 2 | Catastrophic Release from Waste Disposal Area 1 | Receptor 3B, Hypothetical Potable Well | 110 |
| | | Receptor 1, Chicamacomico Tributary | 250 |
| 3 | Chronic Release from Waste Disposal Area 2 | Receptor 3A, Hypothetical Potable Well | 62 |
| | | Receptor 2, Irrigation Well | 125 |
| 4 | Catastrophic Release from Waste Disposal Area 2 | Receptor 3A, Hypothetical Potable Well | 90 |
| | | Receptor 2, Irrigation Well | 125 |
| 5 | Chronic Release from Coal Pile Storage | Receptor 3C, Hypothetical Potable Well | 270 |
| | | Receptor 4, Plant Production Well | 129 |
| 6 | Catastrophic Release from Coal Pile Runoff Retention Basin | Receptor 3C, Hypothetical Potable Well | 666 |
| | | Receptor 4, Plant Production Well | 714 |

Adverse impacts to the irrigation well from potential ground water quality degradation are projected to be negligible (Table 4-18). Compared to drinking water standards, MCLs and SMCLs are not exceeded, with the possible exception of nitrite. The projected nitrite levels are just below the MCL of 1 mg/l. However, this should not be a concern as the irrigation well is not used as a source of drinking water. Compared to existing site ground water quality (Table 3-5), the projected maximum concentrations are similar. TDS and sulfate are projected at slightly higher concentrations than under existing site conditions.

Adverse impacts to the Chicamacomico River tributary are not expected based on comparison to Maryland and federal surface water quality criteria (Table 4-18). With the exception of silver, projected maximum concentrations were generally orders of magnitude below water quality criteria. However, it is unlikely that the maximum concentrations of silver would be realized for the following reasons.

- Silver occurs in solid form when associated with chloride, iron, and sulfur (Fetter 1993). Since chloride, iron and sulfur are constituents of ground water in the Columbia Aquifer, very little, if any, soluble silver should be present in the ground water.